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Collection of malting barley varieties in the Czech Republic in 2005

This study presents the results of micromalting and analyses of malt and wort made from 22 widespread and new varieties of malting barley registered in the Czech Republic. The submitted paper follows earlier studies of Psota, Kosař (1996) and Psota et al. (2001) and it documents changes in the collection of malting barley varieties in the Czech Republic in the last period.

Descriptors: Barley, variety, malting quality

1 Introduction

Several significant factors influenced the structure of the most widespread varieties of malting barley in the Czech Republic during the last period: The major factor was a change of the owners of malt houses. Today, approximately 80 % of production capacity of malt houses in the territory of the Czech Republic has been owned by the firms Sladovny Soufflet ČR, a. s. (Groupe Soufflet) and Plzeňský Prazdroj, a. s. (SABMiller).

In 2002 system of malting quality index calculation was modified. Values of relative extract at 45 °C and Kolbach index exceeding 53 % are considered undesirable. The upper limit for β -glucan content in wort was raised to 250 mg/l (Psota, Kosař 2002).

In January 2003 the Commission on Evaluation of Malting Barley Quality at the RIBM, Plc. pointed out the following facts (Psota 2003): "Current requirements on malting barley quality prefer only the varieties with strong enzymatic activity, high extract level and high values of apparent final attenuation. Due to this pressure, the varieties with a lower level of final attenuation bringing residual extract characteristic for the Czech-style beer (lager) leave the Czech collection of varieties gradually." The following parameters of the malting barley varieties suitable for production of the Czech beer were proposed: extract in malt d.m. (%) min. 81.5 %, relative extract at 45 °C max. 38 %, Kolbach index 39 + 1 %, diastatic power min. 220 u. WK, apparent final attenuation max. 80 %, friability min. 75 %, β -glucans in wort max. 250 mg/l.

In addition, since 2003, wort opalescence has been judged more strictly. It was agreed that the varieties with wort opalescence would be regarded as non-malting even though the other followed technological parameters were convenient.

Other factors affecting the variety composition were changes in legislative: acceptance of the Act No. 219/2003 Coll., on the marketing of seed and planting material of cultivated plants) and admission of the Czech Republic to the European Union on May 28 2003. Today 66 spring and winter barley varieties are registered in the Czech Republic, 34 varieties of which being of malting quality. Study focuses only on 22 most widespread and newly registered varieties of malting barley in the Czech Republic.

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Tables and Figures see Appendix.

2 Data on micromalting

Grain for micromalting is supplied from the state varietal trials of Central Institute for Supervising and Testing in Agriculture. For these trials the certified seed is used. Each year after harvest grain samples of control varieties are taken from all trials for protein content assessment. Samples of the complete collection of the varieties are then micromalted and analysed from four localities in which the control varieties had optimum protein content. Thus it is secured that the determined malting quality characteristics are not negatively affected by unfavourably low or on the contrary high protein content.

2.1 System of micromalting

Sieving fractions of barley grains over 2.5 mm are used for micromalting (EBC 1999). Micromalting started in November in a micromalting plant of the company KVM (CZ) when post harvest maturation was completed. The micromalting plant is computer-controlled and it is possible to adjust and maintain needed conditions in the course of malting.

Micromalting test procedure is based on the traditional method used in the Malting Institute RIBM in Brno and the recommended experimental malting accepted on the 102nd session of the EBC Commission on Barley and Malt in Perugia on May 31 2000.

2.2 Evaluation of varieties

In the tested varieties, malting quality analysis data are evaluated (proteins in barley, extract, relative extract at 45 °C, Kolbach index, diastatic power, apparent final attenuation, friability and β -glucan content in wort). Further malting properties examined during testing are viscosity, wort colour, etc. Malting characteristics mentioned in the study were assessed according to Analytica-EBC (1998) and MEBAK (1997).

3 Analysis of malt and wort

3.1 Spring barley – list of recommended varieties

Since 2000 share of foreign varieties in the collection of varieties of the Czech Republic has increased. In 2004 Czech varieties occupied 30 % of the grain production areas, Slovak varieties 5 % and the rest, i.e. 65 %, was formed by other foreign varieties (Psota 2005).

Average values of the technological characteristics for the period of 2001-2004 are shown in table (Table 1). These mean values

were obtained on the basis of totally 16 observations (4 years per 4 localities).

It is evident from the table that starch modification in the followed set was on a good level. The set contains four varieties with content below 81.5 %. Ten varieties had extract yield higher than 82.0 %. Four-year average in the variety Biatlon was even higher than 83.0 %. Degradation of nitrogenous substances was on the optimum level. The average value of Kolbach index was in the examined set 44.3 % at 0.75 % of soluble nitrogen. The variety Biatlon showed strong activity of proteolytic enzymes (49.0 %).

Negative difference between Kolbach index and relative extract at 45 °C occurred only in the variety Prestige.

Lower values of relative extract at 45 °C and Kolbach index required for malts intended for the Czech beer production were shown by the varieties Tolar and Amulet.

Average values of friability (85.0 %), β -glucan content in wort (160 mg/l) and viscosity show excellent capacity of the tested varieties to degrade cell walls. Only the varieties Calgary, Amulet, and Scarlett had average friability values lower than 80.0 %. Low activity of cytolytic enzymes in the variety Scarlett was also confirmed by high β -glucan content in wort (320 mg/l).

Activity of amylolytic enzymes (first of all β -amylase) was in the followed set of varieties on the optimum level (355 WK u.). Value of diastatic power did not drop below 300 WK u. in any variety

Wort quality expressed by the value of the apparent final attenuation was 81.9 %. The varieties Prestige, Nitran, and Jersey are the varieties with high attenuation. On the contrary, varieties with values of apparent final attenuation to 80 % are required for production of the Czech beer. This requirement was fulfilled best by the varieties Amulet and Kompakt.

3.2 Spring barley – varieties registered in 2005

In 2005 the varieties Bojos, Class, Radegast, Sebastian, and Timori were registered based on the three-year tests (2002-2004) (Table 2).

Starch modification in the Czech variety Bojos was excellent and average extract yield attained the value of 82.9 %. Degradation of nitrogenous substances was on the optimum level too. Average value of Kolbach index was 43.4 % at 0.73 % of soluble nitrogen. Values of friability, β -glucan content in wort and viscosity reflect excellent capacity of the variety to degrade cell walls. Activity of amylolytic enzymes was on the optimum level. For the average values of relative extract at 45 °C (37.4 %) and final apparent attenuation (80.4 %) the variety Bojos was classified as the variety suitable for the Czech beer production.

British Class had excellent extract yield. Modification of nitrogenous substances was on the optimum level. Average value of relative extract at 45 °C was 42.8 %. Degradation of cell walls given by friability and β -glucan content in wort was on the average level. The variety exhibited optimum potential of diastatic power. Wort composition allowed high attenuation.

The Czech variety Radegast had extract yield 82.5 %. Degradation of nitrogenous substances was on the optimum level. Average value of Kolbach index was 43.8 % at 0.76 % of soluble nitrogen in malt. Degree of cell wall degradation was not characterized unambiguously. Viscosity and β -glucan content in wort were on the above-average level. On the contrary, average friability value was low. For its average values of relative extract at 45 °C and

apparent final attenuation the variety Radegast was placed among the varieties suitable for the Czech beer production.

The Danish variety Sebastian showed excellent starch modification and its extract yield was 83.0 %. With values of 0.72 % of soluble nitrogen in malt it exhibited the optimum level of degradation of nitrogenous substances. Average value of relative extract at 45 °C was 40.3 %. Activity of amylolytic enzymes (first of all of β -amylase) was high. Values of friability, β -glucan content in wort and value of viscosity reflect the excellent ability of the variety to modify cell walls. Wort quality enabled high attenuation.

The variety Timori is of a Holland origin. The variety exhibits a very low activity of lipoxigenase (LOX). The activity of this enzyme is considered to be responsible for negative sensory changes occurring in the course of beer aging. This property was patented (Pct international: WO02053720A20020711) and the patentees are the companies Carlsberg, Kronenbourg and Heineken. Compared to the varieties Jersey, Malz, Prestige, and Tolar in the caryopses of which LOX activity in the range of 272-314 U/mg prot. was detected in the RIBM's laboratories, activity in the variety Timori was only 17 U/mg prot. It was not possible to measure LOX activity in the variety in malt. In controls, the detected LOX activity was within 23-50 U/mg prot. Extract yield in wort was in the variety Timori low. Activity of proteolytic enzymes was average. Degradation of cell walls was on a low level. Activity of amylolytic enzymes was on the optimum level. Average value of relative extract at 45 °C was 40.8 %. Wort composition allows higher attenuation.

4 Summary

In 2001-2004 the set of 22 spring barley varieties with malting quality registered in the Czech Republic was evaluated. The varieties Biatlon, Malz, Nitran, and Scarlett exhibited high extract yield in malt dry matter (over 82.5 %). Majority of the followed spring barley varieties showed optimum level of proteolytic modification. The variety Biatlon with a high value of Kolbach index and the variety Tolar with a lower value of this trait were the only exceptions. The variety Prestige had negative difference between relative extract at 45°C and Kolbach index. Activity of amylolytic enzymes was in all the followed varieties on the optimum level. The same holds true about wort composition. Cytolytic modification was weakness of the varieties Calgary, Amulet, and Scarlett. The variety Scarlett was the only one with β -glucan content higher than 250 mg/l.

Based on the results of tests for the registration that held in 2002-2004, the following spring barley varieties were registered in the Czech Republic in 2005: Bojos, Class, Radegast, Sebastian and Timori. The varieties Bojos and Radegast, mainly due to lower apparent final attenuation, were recommended for production of the Czech beer. The varieties Class and Sebastian have high extract yield and show higher degree of attenuation. The variety Timori with low extract yield was registered for low activity of lipoxigenase.

5 Literature

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Appendix

Table 1 Average values of the technological characteristics (2001 - 2004)

Methods	Units	Varieties																
		Amulet	Kompakt	Tolar	Scarlett	Nordus	Jersey	Annabell	Malz	Saloon	Prestige	Philadelphia	Diplom	Respekt	Batlon	Calgary	Faustina	Nitran
Protein content of barley (factor 6.25)	%	11,6	11,0	11,3	11,0	11,6	10,6	10,9	10,8	10,4	10,7	11,0	11,1	11,2	10,4	11,0	11,0	10,7
Extract of malt, congress mash	%	81,4	82,3	81,0	82,5	82,4	82,0	81,4	82,9	82,2	82,1	81,7	82,4	82,2	83,2	81,4	81,9	82,8
Mash method according to Hartong and Kretschmer VZ 45 °C	%	35,8	41,8	34,8	40,4	41,3	44,0	37,1	39,0	43,9	46,0	36,7	40,6	42,6	45,5	38,8	37,3	41,7
Kolbach index	%	41,5	45,4	40,2	43,5	45,9	47,0	42,4	43,6	45,3	44,7	42,1	45,3	45,0	49,0	41,5	44,4	46,4
Diastatic power	WK u	373	347	429	351	383	382	263	312	364	421	342	315	386	301	342	300	420
Final attenuation of laboratory wort from malt	%	80,8	80,5	81,8	81,5	81,2	82,7	81,5	81,6	82,7	83,2	82,2	82,6	81,6	81,4	82,6	81,4	82,9
Friability	%	77	88	83	79	87	89	90	85	83	83	84	85	81	90	75	87	91
High molecular weight b-glucan content of malt, FIA	mg/l	200	101	181	320	88	136	85	202	140	149	161	139	237	120	227	126	116
Protein content of malt (factor 6.25)	%	11,2	10,7	11,0	10,6	11,3	10,2	10,6	10,4	10,0	10,3	10,7	10,8	10,8	10,0	10,6	10,5	10,3
Total nitrogen of malt, Dumas method	%	1,80	1,71	1,76	1,70	1,81	1,63	1,69	1,67	1,60	1,64	1,71	1,72	1,72	1,61	1,69	1,69	1,65
Soluble nitrogen of malt, Dumas method	mg/l	768	798	727	760	851	789	739	748	755	755	740	806	799	813	726	771	790
Soluble nitrogen of malt, Dumas method	%	0,74	0,77	0,70	0,74	0,83	0,76	0,71	0,73	0,72	0,73	0,72	0,78	0,77	0,79	0,70	0,75	0,76
Glycidic (saccharidic) extract of malt	%	76,8	77,4	76,6	77,9	77,2	77,2	76,9	78,4	77,6	77,5	77,2	77,5	77,3	78,3	77,0	77,2	78,0
Viscosity of laboratory wort from malt	mPa.s	1,49	1,45	1,46	1,50	1,45	1,45	1,45	1,48	1,45	1,46	1,45	1,45	1,48	1,45	1,48	1,45	1,45
Colour of malt, visual method	EBC u	3,4	3,3	3,1	3,2	3,6	3,3	3,5	3,0	3,6	3,2	3,1	3,1	3,3	3,3	3,4	3,3	3,3
Saccharification time	min	10,75	10,19	11,03	10,00	10,00	10,00	10,38	10,38	10,00	10,16	10,84	10,00	10,16	10,00	10,00	10,19	10,16
Glassy corns	%	0,3	0,1	0,2	0,3	0,3	0,2	0,1	0,1	0,3	0,2	0,1	0,2	0,3	0,1	0,4	0,1	0,1
Homogeneity (by friabilimeter)	%	93,5	98,4	95,9	90,9	97,5	97,8	98,3	95,7	95,0	95,6	97,0	96,6	94,2	98,0	90,9	97,0	98,6
Appearance (clarity) of wort		1,06	1,50	1,06	1,63	1,88	1,00	2,06	1,00	1,00	1,00	1,50	1,00	1,06	1,00	1,31	1,00	1,00

Table 2 New barley varieties - average values of the technological characteristics (2002 - 2004)

Methods	Units	Varieties				
		BOJOS	CLASS	RADEGAST	SEBASTIAN	TIMORI
Protein content of barley (factor 6.25)	%	10,9	10,7	11,2	10,4	10,6
Extract of malt, congress mash	%	82,9	82,9	82,5	83,0	81,2
Mash method according to Hartong and Kretschmer VZ 45 °C	%	37,4	42,8	37,8	40,3	38,9
Kolbach index	%	43,4	43,1	43,8	45,0	40,8
Diastatic power	WK	383	418	382	415	339
Final attenuation of laboratory wort from malt	%	80,4	83,2	79,4	82,6	82,0
Friability	%	86	81	79	84	79
High molecular weight b-glucan content of malt, FIA	mg/l	117	172	141	127	232
Protein content of malt (factor 6.25)	%	10,5	10,4	10,9	10,0	10,2
Total nitrogen of malt, Dumas method	%	1,68	1,66	1,74	1,60	1,62
Soluble nitrogen of malt, Dumas method	mg/l	729	713	763	719	662
Soluble nitrogen of malt, Dumas method	%	0,73	0,71	0,76	0,72	0,66
Glycidic (saccharidic) extract of malt	%	78,4	78,5	77,7	78,6	77,0
Viscosity of laboratory wort from malt	mPa.s	1,44	1,46	1,46	1,46	1,48
Colour of malt, visual method	EBC	3,0	3,0	3,0	3,4	3,0
Saccharification time	min	10,25	10,00	10,50	10,25	10,50
Glassy corns	%	0,16	0,21	0,32	0,22	0,20
Partly unmodified grains	%	3,0	4,8	6,1	3,9	5,0
Homogeneity (by friabilimeter)	%	96,8	95,0	93,6	95,8	94,8
Appearance (clarity) of wort		1,00	1,00	1,00	1,00	1,00
Haze of wort (90°)	EBC	0,59	0,70	0,75	0,89	0,78
Haze of wort (15°)	EBC	0,58	0,64	0,78	0,96	0,79